DM6888HR
Isolated digital I/O-module
User's Manual

Hardware Revision 1.1

Preliminary

RTD FINLAND Oy

DM6888HR
ISOLATED DIGITAL I/O-MODULE
User's Manual

REAL TIME DEVICES FINLAND OY
LEPOLANTIE 14
FIN-00660 HELSINKI
FINLAND

Phone: (+358) 9 346 4538
FAX: (+358) 9 346 4539

E-Mail
sales@rtdfinland.fi

Website

Revision History

20/09/2003	Initial version

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Published by
RTD Finland Oy
Lepolantie 14
FIN-00660 Helsinki
Finland

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Chapter 1 INTRODUCTION

This user's manual describes the operation of the DM6888HR high-density isolated digital interface boards.

Features

Some of the key features of the DM6888HR include:

- 16 channel-by-channel isolated open collector digital outputs, 8mA @ 30V
- 48 optocoupler inputs with reverse voltage protection
- Single +5V operation, low power +3,3V design
- Customer specified functions may be added to board control CPLD
- RTD IDAN compatible
- Support for direct PC/104 interface with RTD dataModules
- PC/104 compliant

The following paragraphs briefly describe the major features of the DM6888HR. A more detailed discussion is included in Chapter 3 (Hardware description), and in Chapter 4 (Board operation and programming). The board set-up is described in Chapter 1 (Board Settings).

Isolated Digital Outputs

16 optocoupler outputs may be used to directly drive loads, such as relays, lamps or to interface to commonly encountered 24V PLC I/O's. The outputs are driven with an open collector optocoupler output capable of sinking 8mA at 30V. Each output channel can be connected to a different potential. The isolated outputs are controlled with a latch structure.

Isolated Digital Inputs

48 optocoupler inputs may be used to connect high voltage signals to a computer. Eight channel-by-channel isolated input ranges are available. The factory installed input range is +5V, but this input range may be customized channel-by-channel by changing the input series resistors. The optocoupler inputs have a reverse voltage protection diode across the input. This enables AC-connection to the inputs where the input diode acts as a rectifier.

Mechanical description

The DM6888HR is designed on a PC/104 form factor. An easy mechanical interface to both PC/104 and EUROCARD systems can be achieved. Stack your PC/104 compatible computer directly on the DM6888HR using the onboard mounting holes.

Connector description

There are three 50-pin digital interface connectors on the DM6888HR to directly interface isolated digital I/O signals. Isolated inputs and outputs are connected to the board by 50-pin flat ribbon cable connectors. Use this type of interface connector with a TB50 screw terminal block.

What comes with your board?

Your DM6888HR package contains the following items:

- DM6888HR Isolated Digital Interface module
- User's manual

Note: Software and diagnostics programs and WIN95/98/2000/XP/NT 4.0 and Linux are available free of charge on our website www.rtdfinland.fi

If any item is missing or damaged, please call Real Time Devices Finland customer service department at the following number: (+358) 9 346 4538.

Board accessories

In addition to the items included in your DM6888HR delivery, several software and hardware accessories are available. Contact your distributor for more information and for advice on selecting the most appropriate accessories to support your instrumentation system.

- **Application software and drivers**

- **Hardware accessories**

Real Time Devices can supply a complete set of accessories for your DM6888HR card. These include, power supplies, terminal boards (TB50), and other connection systems. The board is also available in the rugged FENIX, IDAN and HiDAN enclosure systems. Please consult the factory for more details or visit our websites at www.rtdfinland.fi or www.rtd.com.

Using this manual

This manual is intended to help you install your new board and get it working quickly, while also providing enough detail about the board and it's functions so that you can enjoy maximum use of it's features even in the most demanding applications.

When you need help

This manual and all the example programs will provide you with enough information to fully utilize all the features on this board. If you have any problems with installation or use of the board, contact our Technical Support Department (+358) 9 346 4538 during European business hours. Alternatively, send a FAX to (+358) 9 346 4539, or Email to: techsupport@rtdfinland.fi. When sending a FAX or Email request please include the following information: Your company's name and address, your name, your telephone number, and a brief description of the problem.

Chapter 2 BOARD SETTINGS

The DM6888HR Isolated digital I/O board has jumper settings which can be changed to suit your application. It is factory configured with a +5V input range configuration. The factory settings are listed and shown in the diagram in the beginning of this chapter.

Factory-Configured Jumper Settings

Table 2-1 below illustrates the factory jumper setting for the DM6888HR. It also shows the board layout of the DM6888HR and the locations of the jumpers. The following paragraphs explain how to change the factory jumper settings to suit your specific application.

*Table 2-1: Factory jumper settings (*see figure 2-1 below for detailed locations)

Jumper name	Jumper description	Number of Jumpers	Factory setting jumpers installed
Base address	Base address	8	300h

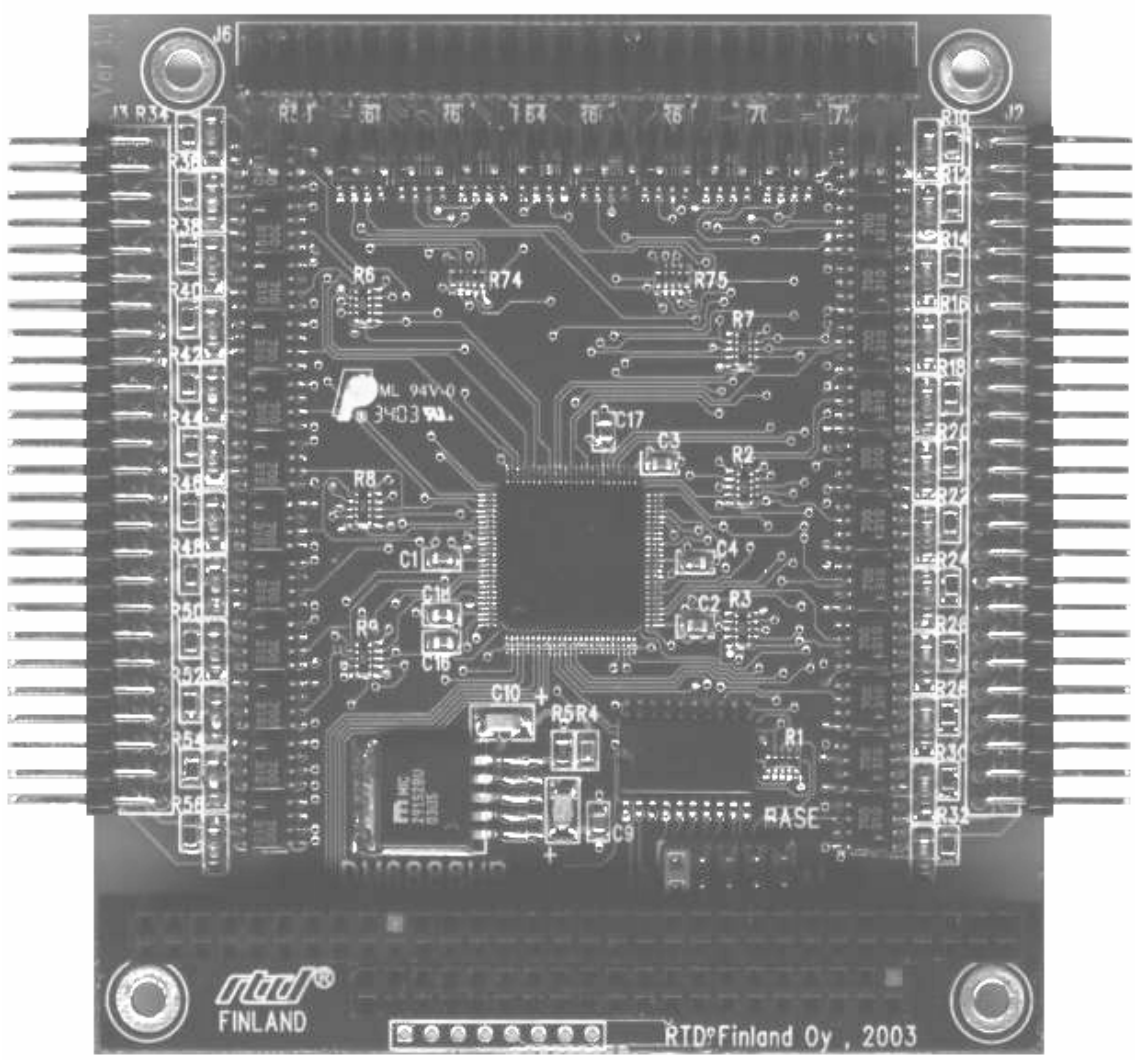


Figure 2-1 - Board layout showing jumper locations

Base address Jumpers (Factory setting: 300h)

The most common cause of failure when you are first setting up your module is address contention. Some of the I/O space of your computer is already occupied by other internal I/O devices and expansion boards. When the board attempts to use it's own reserved I/O addresses (which are being already used by another peripheral device), erratic performance may occur and the data read from the board may be corrupted.

To avoid this problem make sure you set up the base address first using the eight jumpers marked "BASE", that are near the PC/104 bus connector. It allows you to choose from 256 different I/O addresses in your computer I/O map. Should the factory installed setting of 300h be unusable for your system configuration, you may change this setting to another using the options illustrated in Table 2-2 (overleaf). The table shows the switch settings and their corresponding values in hexadecimal values. Ensure that you verify the correct location of the base address jumpers. When the jumper is removed it corresponds to a logical "0", connecting the jumper to a "1". When you set the base address of the module, record the setting inside the back cover of this manual (directly after the Appendices).

BASE ADDRESS JUMPER SETTINGS FOR DM6888HR BOARDS

Base address Hex / (Decimal)	Jumper Settings 8 7 6 5 4 3 2 1	Base Address Hex / (Decimal)	Jumper settings 8 7 6 5 4 3 2 1
200 / (512)	0 0 0 0 0	300 / (768)	1 0 0 0 0
210 / (528)	0 0 0 0 1	310 / (784)	1 0 0 0 1
220 / (544)	0 0 0 1 0	320 / (800)	1 0 0 1 0
230 / (560)	0 0 0 1 1	330 / (816)	1 0 0 1 1
240 / (576)	0 0 1 0 0	340 / (832)	1 0 1 0 0
250 / (592)	0 0 1 0 1	350 / (848)	1 0 1 0 1
260 / (608)	0 0 1 1 0	360 / (864)	1 0 1 1 0
270 / (624)	0 0 1 1 1	370 / (880)	1 0 1 1 1
280 / (640)	0 1 0 0 0	380 / (896)	1 1 0 0 0
290 / (656)	0 1 0 0 1	390 / (912)	1 1 0 0 1
2A0 / (672)	0 1 0 1 0	3A0 / (928)	1 1 0 1 0
2B0 / (688)	0 1 0 1 1	3B0 / (944)	1 1 0 1 1
2C0 / (704)	0 1 1 0 0	3C0 / (960)	1 1 1 0 0
2D0 / (720)	0 1 1 0 1	3D0 / (976)	1 1 1 0 1
2E0 / (736)	0 1 1 1 0	3E0 / (922)	1 1 1 1 0
2F0 / (752)	0 1 1 1 1	3F0 / (1008)	1 1 1 1 1

0 = NOT JUMPERED, 1 = JUMPER INSTALLED

Table 2-2: Base Address jumper settings, factory default Base Address shaded

Note: In the table above only the MSB address decoder jumper settings are illustrated. You may also connect jumpers 1-3 to decode address lines A1-A3

Chapter 3 BOARD INSTALLATION

The DM6888HR Isolated Digital Interface board is very easy to connect to your industrial or automotive control system. Direct interface to PC/104 systems as well as EUROCARD boards is possible. This chapter gives step-by-step instructions on how to install the board into your system.

After completing the installation it is recommended that you use the diagnostic software to fully verify that your board is working.

Board Installation

Keep your board in the antistatic bag until you are ready to install it to your system! When removing it from the bag, hold the board at the edges and do not touch the components or connectors. Please handle the board in an antistatic environment and use a **grounded** workbench for testing and handling of your hardware. Before installing the board in your computer, check the jumper settings. Chapter 1 reviews the factory settings and how to alter them. If any alterations are needed, please refer to the appropriate instructions in this chapter. Do however note that incompatible settings can result in unpredictable board operation and erratic response.

General installation guidelines:

- Turn OFF the power to your computer
- Touch the grounded metal housing of your computer to discharge any antistatic build-up and then remove the board from its antistatic bag.
- Hold the board by the edges and install it in an enclosure or place it on the able on an antistatic surface.
- Connect the board to the I/O devices using the twisted pair 50-pin flat cables

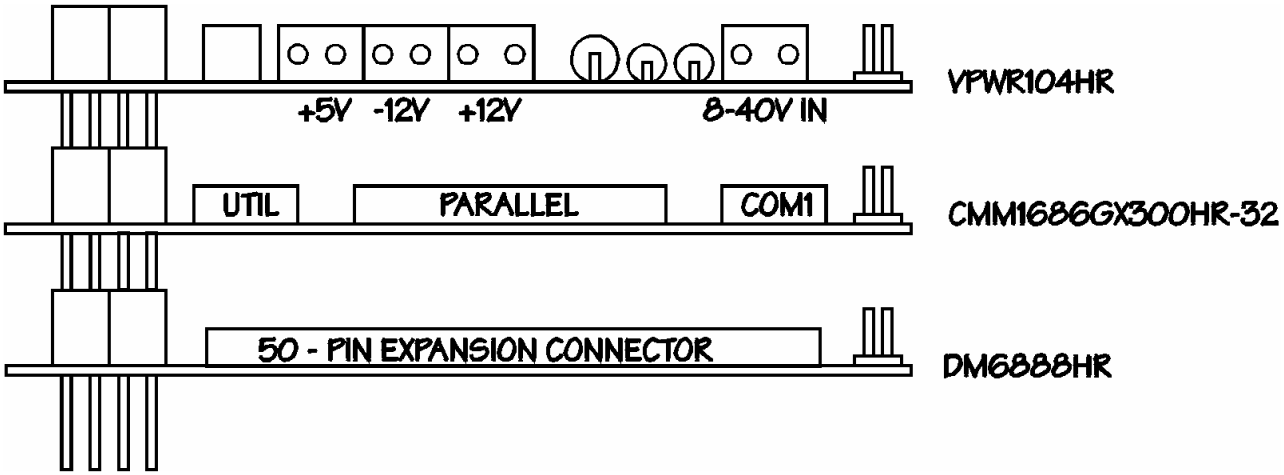


Fig. 3-1: DM6888HR integrated in a PC/104 RTD cpuModule stack

External I/O Connections

Table 3-1 below shows the input wire connection pinouts that are identical for both 50-pin input connectors J2 and J3.

PIN number	Signal Description	PIN number	Signal Description
1	+ **IN1**	2	**- IN1**
3	**+ IN2**	4	**- IN2**
5	**+ IN3**	6	**- IN3**
7	**+ IN4**	8	**- IN4**
9	**+ IN5**	10	**- IN5**
11	**+ IN6**	12	**- IN6**
13	**+ IN7**	14	**- IN7**
15	**+ IN8**	16	**- IN8**
17	**+ IN9**	18	**- IN9**
19	**+ IN10**	20	**- IN10**
21	**+ IN11**	22	**- IN11**
23	**+ IN12**	24	**- IN12**
25	**+ IN13**	26	**- IN13**
27	**+ IN14**	28	**- IN14**
29	**+ IN15**	30	**- IN15**
31	**+ IN16**	32	**- IN16**
33	**+ IN17**	34	**- IN17**
35	**+ IN18**	36	**- IN18**
37	**+ IN19**	38	**- IN19**
39	**+ IN20**	40	**- IN20**
41	**+ IN21**	42	**- IN21**
43	**+ IN22**	44	**- IN22**
45	**+ IN23**	46	**- IN23**
47	**+ IN24**	48	**- IN24**
49	NC	50	NC

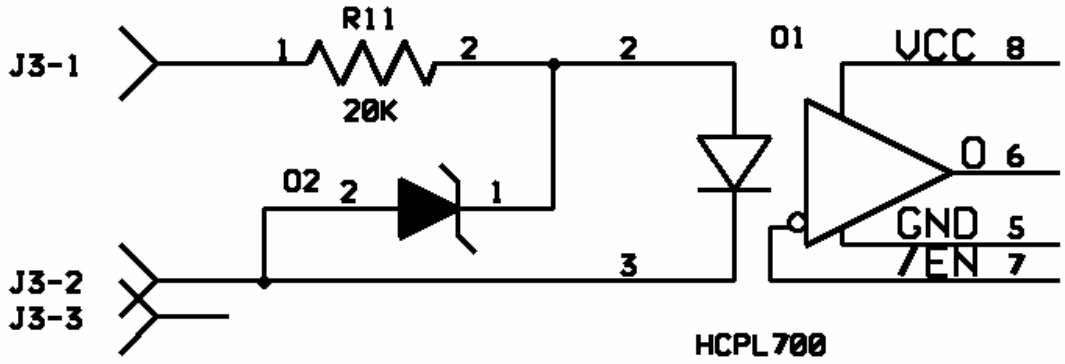
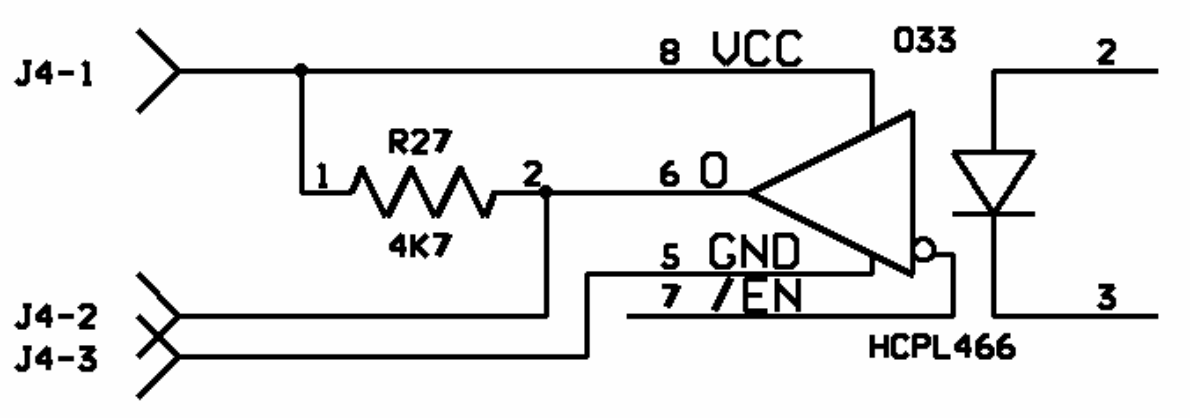


Fig: 3-3: This diagram illustrates the input connection for channel 1

Table 3-2 below shows the **output** connection pinouts of connector J6

Pin number	Signal description	Pin number	Signal Description
1	**+Vsupply-1**	2	**Out1**
3	**GND-1**	4	**+Vsupply-2**
5	**Out2**	6	**GND-2**
7	**+Vsupply-3**	8	**Out3**
9	**GND-3**	10	**+Vsupply-4**
11	**Out4**	12	**GND-4**
13	**+Vsupply-5**	14	**Out5**
15	**GND-5**	16	**+Vsupply-6**
17	**Out6**	18	**GND-6**
19	**+Vsupply-7**	20	**Out7**
21	**GND-7**	22	**+Vsupply-8**
23	**Out8**	24	**GND-8**
25	**+Vsupply-9**	26	**Out9**
27	**GND-9**	28	**+Vsupply-10**
29	**Out10**	30	**GND-10**
31	**+Vsupply-11**	32	**Out11**
33	**GND-11**	34	**+Vsupply-12**
35	**Out12**	36	**GND-12**
37	**+Vsupply-13**	38	**Out13**
39	**GND-13**	40	**+Vsupply-14**
41	**Out14**	42	**GND-14**
43	**+Vsupply-15**	44	**Out15**
45	**GND-15**	46	**+Vsupply-16**
47	**Out16**	48	**GND-16**
49	NC	50	NC



3-4: This diagram illustrates the output connection for channel 1

Chapter 4 - HARDWARE DESCRIPTION

This chapter describes in detail the two major features of the DM6888HR: The isolated optocoupler inputs and the isolated optocoupler outputs.

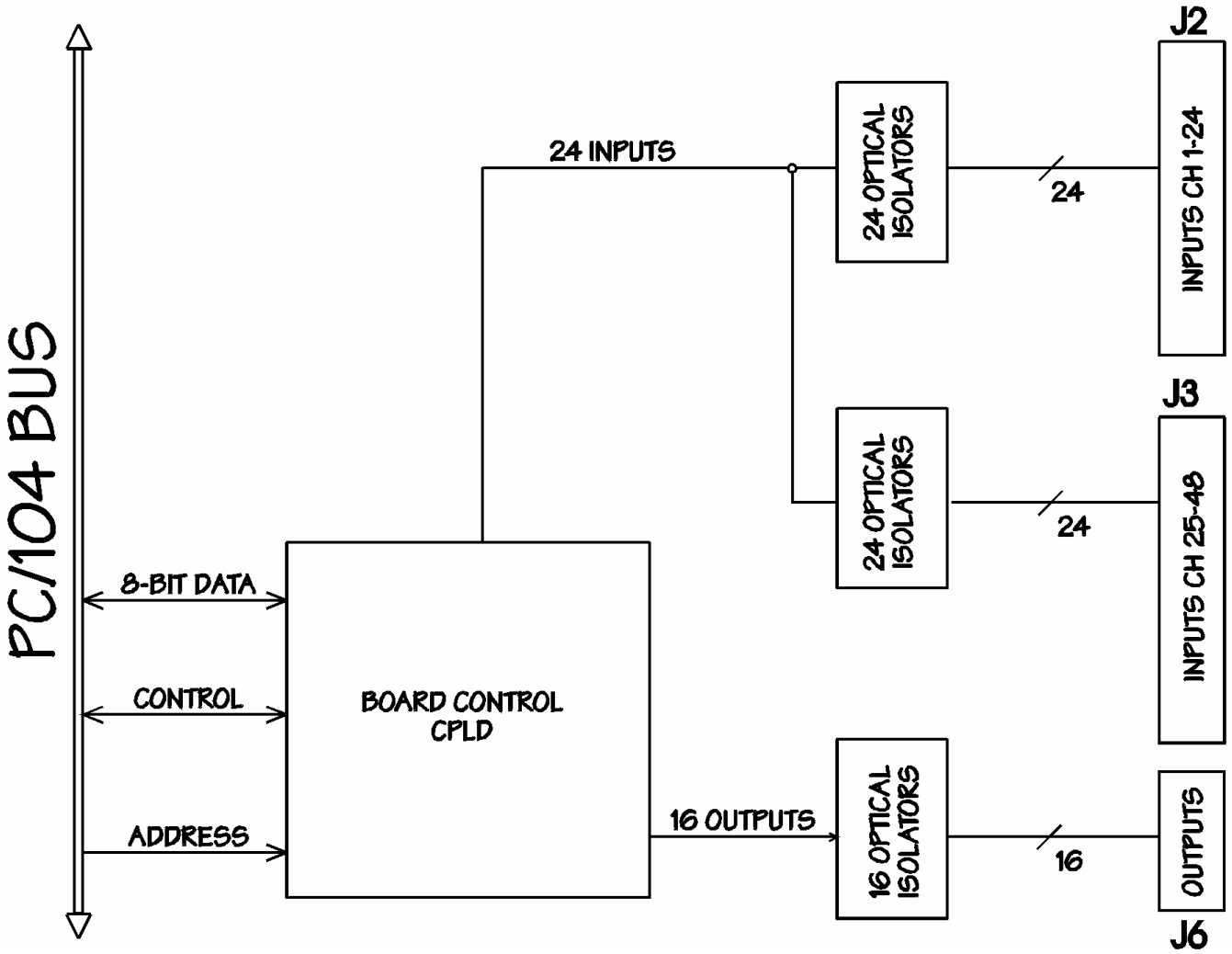


Fig 4-1: DM6888HR Block diagram

Isolated digital inputs

The Isolated output stage of the DM6888HR consists of two major parts:

1. Optocouplers
2. Input latches

1. Optocouplers

Small SMD-optocouplers are used to isolate each channel of the isolated inputs. Individual optocouplers are used for each channel. The optocouplers are directly connected to the input latch in an inverting configuration. A reverse voltage protection diode is connected across the optocoupler input.

The input voltage range can be customized channel-by-channel by changing the input series resistor. The factory preinstalled input voltage is +5V (or TTL). The threshold voltage is approximately 3,2 to 3,4V. To customize the input range to a different one, please change the input resistor. The nominal value of the +5V range input resistor is 20 KOhm.

The absolute maximum forward current of the optocoupler is 20mA. The maximum allowed voltage with the factory set +5V range is 18V!

2. Input latches

The inverting optocouplers are connected to two 8-bit data latches that are directly addressable with a read operation starting from address BASE+0x02 to BASE+0x08.

Isolated digital outputs

The Isolated output stage of the DM6888HR consists of two major parts:

1. Optocouplers
2. Output registers

1. Optocouplers

Small SMD-optocouplers are used to isolate each channel of the isolated outputs. Individual optocouplers are used for each channel. The optocouplers are directly connected to the Output latch. The output optocoupler transistor is in the open collector configuration with a pull-up resistor, which is connected to the collector. A 4,7 KOhm resistor is used as a pull-up to the supply. The output 4.7 Kohm pull-up resistor has been installed for a +5 - 30V isolated output range.

2. Output registers

The optocouplers are connected to two 8-bit data registers, which are directly addressable with a write operation at address BASE+0x01 and BASE+0x02. The state of the outputs does not change even though a system reset may occur. A write to the output latch will update the state of the outputs.

Chapter 5 - BOARD OPERATION AND PROGRAMMING

This chapter shows you how to program and use your DM6888HR: It provides a complete description of the I/O-map plus a detailed discussion of programming operations to aid you in programming.

Defining the I/O Map

The I/O map of the DM6888HR is shown in Table 5-1 below. As shown, the module occupies two addresses. The Base Address (designated as BA) can be set using the jumpers as described in Chapter 2 (Board settings). The following sections describe the register contents of each address used in the I/O map.

Table 5-1: DM6888HR I/O Map

Register Description	Read Function	Write Function	Address in HEX
RESERVED	Do not use	Do not use	BA+0x00
Output register #1	Readback ch. 1-8	Outputs ch. 1-8	BA+0x01
Output register #2	Readback ch. 9-16	Outputs ch. 9-16	BA+0x02
Input register #1	Inputs ch. 1-8	Not defined	BA+0x03
Input register #2	Inputs ch. 9-16	Not defined	BA+0x04
Input register #3	Inputs ch. 17-24	Not defined	BA+0x05
Input register #4	Inputs ch. 25-32	Not defined	BA+0x06
Input register #5	Inputs ch.33-40	Not defined	BA+0x07
Input register #6	Inputs ch. 41-48	Not defined	BA+0x08

BA = Base Address

BA+0 Reserved, Do not use

BA+1 Digital Outputs 9-16 (Write/Read)

The optoisolated digital output channels 1-8 can be written through address BA+0x01.

BA+2 Digital Outputs 9-16 (Write/Read)

The optoisolated digital output channels 9-16 can be written through address BA+0x02.

BA+3 to BA+8 Digital Inputs (Write)

The data input registers return the input optocoupler data.

Programming the DM6888HR

This section gives you some general information about programming the DM6888HR board. It then walks you through the major programming functions of the DM6888HR. This will help you use the example program that is included with the board. All of the program descriptions use decimal values unless otherwise specified.

The DM6888HR board is programmed through a write or a read operation to the correct I/O-port address. These I/O ports were described in the previous section of this chapter. The following example shows how to perform an 8-bit read and write I/O port addresses using "C"-syntax and assembly code:

	Read:	**Write:**
"C"-syntax	var = **inp**(address);	**outp**(address,data);
Assembly	**mov** dx,address **in** ax,dx	**mov** dx,address **mov** ax,data **out** dx,ax

8-bit operations must be performed to the DM6888HR board for correct operation.

Clearing and setting bits in an I/O port

When you clear or set bits in an I/O port you must be careful not to alter the status of other bits. You can preserve the status of all the bits you do not wish to change by proper use of the bit wise AND- and OR- operators. Using and /or operators, single or multiple bits can easily be set or cleared in one-line operations.

1. *To clear a single bit in a port*, AND the current value of the port with the value "B", where B = 255-2(exp) bit.

2. *To set a single bit in a port*, OR the current value of the port with the value "B", where B = 2(exp) bit.

Bits are numbered from 0-7 for the low byte of a word and from 8-15 for the high byte of a word. Setting and clearing of multiple bits in a bye or word is more complex.

3. *To clear multiple bits in a port,* AND the current value of the port with the value "B", where B = 255 - (the sum of the values of the bits to be cleared). Note that the bits do not have to be consecutive.

4. *To set multiple bits in a port*, OR the current value of the port with the value "B", where B = (sum of the individual bits to be set).

Isolated Output Programming

The optoisolated outputs are controlled with a register structure.
These outputs can be commanded in the following ways (examples in "C" syntax):

1. *Software controlled byte write*

```
outp(BA+1,low_byte);
outp(BA+2high_byte);
```

2. *Software controlled direct word write*

```
outpw(BA+1,word);
```

Isolated Input Programming

The optoisolated inputs are read from a data latch.
These inputs can be interrogated in the following ways (examples in "C" syntax):

1. *Software controlled byte read*

```
low_data = inp(BA+3);
high_data = inp(BA+4);
```

2. *Software controlled direct word read*

```
word_data = inpw(BA+3);
```

Chapter 6 - DM6888HR SPECIFICATIONS

Host Interface

Jumper selectable base address, I/O mapped

Digital Outputs (isolated)

Number of lines	16	
Isolation voltage		1.500V Rms
Output stage		Open collector with a 4,8K pull-up 8 mA sink current, 30V
Output supply voltage		+5 to +30V

Digital Inputs (isolated)

Number of lines	48	
Triggering voltage +5V range		3,3V (Approx.)
Maximum input voltage factory default +5V range		18V
Isolation voltage		1.500V Rms

Connectors

Isolated Outputs	50 pin header
Isolated Inputs	50 pin headers
Bus connector	AT-bus connector

Power requirements

Supply voltage	+5V +/- 8% Supply current 175 mA

Operating temperature range

Standard	-40 to +85 C

Chapter 7 RETURN POLICY AND WARRANTY

Return Policy

If the module requires repair, you may return it to us by following the procedure listed below:

Caution: Failure to follow this return procedure will *almost always* delay repair! Please help us expedite your repair by following this procedure.

1) Read the limited warranty, which follows.

2) Contact the factory and request a Returned Merchandise Authorization (RMA) number.

3) On a sheet of paper, write the name, phone number, and fax number of a technically competent person who can answer questions about the problem.

4) On the paper, write a detailed description of the problem with the product. Answer the following questions:

- Did the product ever work in your application?
- What other devices were connected to the product?
- How was power supplied to the product?
- What features did and did not work?
- What was being done when the product failed?
- What were environmental conditions when the product failed?

5) Indicate the method we should use to ship the product back to you.

- We will return warranty repairs by UPS Ground at our expense.
- Warranty repairs may be returned by a faster service at your expense.
- Non-warranty repairs will be returned by UPS Ground or the method you select, and will be billed to you.

6) Clearly specify the address to which we should return the product when repaired.

7) Enclose the paper with the product being returned.

8) Carefully package the product to be returned *using anti-static packaging!* We will not be responsible for products damaged in transit for repair.

7) Write the RMA number on the outside of the package.

8) Ship the package to:

Real Time Devices Finland Oy

Lepolantie 14

FIN-00660 Helsinki

FINLAND

Limited Warranty

Real Time Devices warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from REAL TIME DEVICES. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, REAL TIME DEVICES will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to REAL TIME DEVICES. All replaced parts and products become the property of REAL TIME DEVICES. Before returning any product for repair, customers are required to contact the factory for an RMA number.

THIS LIMITED WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN DAMAGED AS A RESULT OF ACCIDENT, MISUSE, ABUSE (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by REAL TIME DEVICES, "acts of God" or other contingencies beyond the control of REAL TIME DEVICES), OR AS A RESULT OF SERVICE OR MODIFICATION BY ANYONE OTHER THAN REAL TIME DEVICES. EXCEPT AS EXPRESSLY SET FORTH ABOVE, NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND REAL TIME DEVICES EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED HEREIN. ALL IMPLIED WARRANTIES, INCLUDING IMPLIED WARRANTIES FOR MECHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS WARRANTY. IN THE EVENT THE PRODUCT IS NOT FREE FROM DEFECTS AS WARRANTED ABOVE, THE PURCHASER'S SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. UNDER NO CIRCUMSTANCES WILL REAL TIME DEVICES BE LIABLE TO THE PURCHASER OR ANY USER FOR ANY DAMAGES, INCLUDING ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOST PROFITS, LOST SAVINGS, OR OTHER DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, AND SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS, WHICH VARY FROM STATE TO STATE.